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(54) **Preservative compositions for fruits and vegetables.**

(57) A composition for reducing deterioration and/or extending shelf life of fruits and vegetables, particularly for salad bars and prepared salads sold in fast-food restaurants, the composition comprising an antidiscolouration agent such as ascorbic acid and a thixotropic gum such as xanthan. Optionally, other ingredients such as edible bulk filler, artificial or natural flavourings, aromas, and/or colourings may also be present. The composition can be applied in aqueous form to salad ingredients. The salad preserving composition can be well retained by salad ingredients to maintain freshness and extend shelf life without sulphites and without imparting objectionable texture or taste in treated ingredients.

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## PRESERVATIVE COMPOSITIONS FOR FRUITS AND VEGETABLES

This invention relates to a sulphite-free composition for minimising discolouration and/or extending shelf life of foods, particularly fruits and vegetables, more particularly to a preservative composition comprising an organic food acid and a thixotropic gum, and to the use of such compositions for these purposes. For salads a composition comprising xanthan gum alone or combined with other thixotropic gums and ascorbic acid alone or in combination with other edible organic acids is particularly preferred. It may also be desirable to add aroma and/or flavour compounds to enhance the salad flavour.

It has recently become extremely popular for restaurants, fast-food establishments, and even supermarkets to provide salad bars wherein patrons can prepare their own salads from freshly cut vegetables and fruits. However, these various salad ingredients will show physical signs of deterioration, such as wilting, drying, shrinking or browning, with a fairly short time period. After such physical deterioration, these fruits and vegetables are no longer marketable. In addition, certain fast-food restaurants now offer ready-made salads which are prepared and refrigerated, but these too must be discarded if not purchased after a certain period of time. Although the problem of preservation of fresh fruits and vegetables has been with us since these products were first marketed, the problem is a particularly marked one at present due to the great prevalence of freshly cut produce in salad bars and prepared, containered salads which have extremely short shelf lives.

Many attempts have been made over the years to combat the problems of browning, wilting, etc. in cut or whole fruit and vegetable matter. Various methods and compositions have been invented for combatting oxidative deterioration in these products, such as described in U.S. Patents 4,140,649; 3,987,208; 3,814,820; and 3,533,510. In these patents, active agents disclosed for use in preventing deterioration include ascorbic acid, other edible acids, and other sulphites, sodium phosphates, sodium ascorbate, and potassium sorbate. Dry treatment with CMC and optional gums including locust bean, guar, carrageenan, tragacanth, alginates, acacia, bentonite and agar have been used with fruit acids as a dry treatment for fruits to preserve them during heat treatment. It is highly desirable to develop a fruit or vegetable salad preservative which does not contain sulphites, yet which can be used effectively to prolong shelf life particularly for salad bar ingredients and pre-prepared salads. It is also desirable to develop a salad preservative which does not add any objectionable slimy, gummy or heavy mouthfeel to the salad ingredients.

## SUMMARY OF THE INVENTION

In accordance with the present invention, a composition is provided for reducing deterioration and/or extending shelf life of fruits and vegetables which comprises edible organic acid preferably ascorbic acid and an edible thixotropic gum, preferably xanthan. The composition of the present invention is preferably used on salad bar ingredients and in prepared salads so as to ensure freshness, without adding an objectionable gummy mouthfeel to the salad and without the use of sulphites. The composition can also include a bulk filling agent, such as maltodextrin, and natural or artificial flavorings and/or aromas, and may be applied as an aqueous solution.

## DETAILED DESCRIPTION OF NON-LIMITING PREFERRED EMBODIMENTS ONLY

In accordance with the present invention, a composition which extends the shelf life of salad ingredients is provided which comprises an edible organic acid active ingredient and an edible thixotropic gum. It is particularly preferred that the thixotropic gum employed in the present invention comprises xanthan gum which provides a sheer thinning, non-slimy mouth feel. However, many other suitable gums can be used, at least in part, including guar gum, gum tragacanth, carrageenan gum, alginate gum, and karaya gum all which give sheer thinning properties but are less desirable due to their slimy mouth feel. The composition of the present invention also includes food grade organic acid to prevent discoloration. Preferred are ascorbic acid or isoascorbic acid alone or combined with other acids. Other useful food grade organic acids are citric acid, fumaric acid, tartaric acid, malic acid and the like. Where acidity can be tolerated, these acids, particularly citric, could be used alone although it is preferred to include ascorbic acid. Other active antidiscolouration agents, such as cysteine, can be used to replace all or part of the organic acid but are less desirable because of cost and taste.

In the preferred embodiment, the ratio by weight of the antidiscoloration acid to the edible thixotropic gum in the composition will range from about 1:1 to about 30:1, with a range of from about 3:1 to about 5:1 preferred for the antidiscoloration acids. The composition of the present invention can be extremely effective in extending the short shelf life of fresh vegetables and salads, particularly in the case of ingredients prepared for salad bars and over-the-counter prepared salads. The composition of the present invention can be effective in retaining freshness in such salad ingredients without the use of sulfites, and for longer periods of time than previously achievable.

Another application of this composition is a wash in preparing fruits and vegetables for drying.

The composition of the present invention may primarily comprise food grade ascorbic acid and food grade edible xanthan gum, but can also include a food grade bulk filler, such as maltodextrin. Other conventional ingredients such as flavouring and aroma agents and colouring agents may also be included. In general, where a bulk filler is employed, the ratio by weight of the bulk filling agent to the ascorbic acid will range roughly from 0.1 to 10:1, and preferably 0.3:1 to 3:1 and, most preferably, this range will be from about 2/3:1 to about 1.50:1.

It is preferred that the bulk filler used be maltodextrin, particularly low D.E. maltodextrin. The maltodextrin is preferably employed in the form of expanded low density maltodextrin.

A typical composition of the invention may contain the following ingredients by percentage of the total weight of the solid ingredients (dry basis):

- (a) 20-60% edible bulk filler (e.g., maltodextrin)
- (b) 20-60% ascorbic acid
- (c) 1-50% edible xanthan gum.

The solid ingredients can be dissolved in water prior to use although a liquid or aqueous concentrate may be prepared and diluted before use. A bulk filler can improve the consistency of the aqueous solution and the wettability of the dry mix. In the composition of the invention, any conventional readily available food grade ascorbic acid can be employed. Generally, the ascorbic acid should comprise about 20-60% by weight, more preferably 25-50%, of the total weight of the solid ingredients of the composition.

A wide variety of natural and artificial flavouring and/or aromatizing agents can be used in the composition. These agents can be added to the composition comprising edible organic acid and the edible thixotropic gum alone, or can be added to compositions which include a bulk filling agent as well. In general, the flavouring and/or aromatizing agents may be employed in a ratio by weight to the ascorbic acid ranging from about 0.50:1 to about 1:1, with a range of about 0.1:1 to about 0.4:1 particularly preferred. A typical composition of the invention employing a flavouring agent and a bulk filling agent will contain the following ingredients (by weight percentage of the total weight of the solid ingredients):

- (a) 20-60% edible bulk filler (e.g., maltodextrin)
- (b) 20-60% edible organic acid (e.g., ascorbic acid and/or citric acid)
- (c) 1-50% edible thixotropic gum (e.g., xanthan and/or other shear thinning thixotropic gums).
- (d) 1-25% natural or artificial flavouring and/or aroma agent.

An example of a natural flavour and/or aroma usable in the present invention is leaf essence, produced by General Foods, particularly useful with regard to compositions designed to be added to salad ingredients. Artificial lettuce flavouring agents are particularly useful in salads. Any suitable natural or artificial flavour or aroma, however, which is appropriate for a particular application can be used in the invention.

With regard to the gums usable in the present invention, it is generally preferred that a food grade thixotropic gum be employed in an amount ranging from about 1 to about 50% by weight of the total weight of the solid ingredients in the composition, depending on the particular gum chosen. Preferably, the gum should be used at a level of 1-25%, more particularly from 2-20%, and more preferably should comprise about 4-12% of the composition. It is much preferred that the gums employed in the invention be used at these low percentages because when used at higher levels, particularly above 50%, they can add an objectionable mouthfeel to the product and reduce organoleptic acceptability. The composition of the present invention can prevent discoloration of salad ingredients yet may not add objectionable gummy qualities to the salad. It can also retard wilting, drying, and deterioration of the salad. It is thus particularly preferred to use proportions of thixotropic gum(s) as stated above to ensure that the salad ingredients treated maintain organoleptic acceptability.

In preparing the compositions of this invention it is preferable that a major amount of the edible organic acid comprises ascorbic acid, isoascorbic acid and mixtures thereof and, in addition, it is preferable that a major amount of the thixotropic gum comprises xanthan gum.

The composition of the present invention is preferably applied to whole or cut fruits, vegetables, or other salad ingredients in the form of an aqueous solution. The term "solution" is used in a general sense

to include compositions in which one or more of the ingredients is not in true solution. Food grade co-solvents may be employed to facilitate dispersion of ingredients that are not readily dissolved in water. The solution containing the composition can be applied in any convenient and effective manner, such as spraying, dipping, by drops, etc. Ideally, a light spray of the preserving solution over a tray or platter of salad ingredients will be sufficient to apply an effective amount of the composition to the salad. By effective amount is meant that amount necessary to extend the shelf life of the fruit or vegetable ingredient treated. This amount may be in the range of from about 0.1% to 10% by weight of solid ingredients based on the weight of the salad treated, and preferably about 0.2% to 4%.

For individual active agents, the effective amount of thixotropic gum in solution needed to adhere the active ingredient or acid to the salad ingredients may range from 0.01% to 5% by weight of the solution, preferably from 0.01% to 2% by weight of the solution. In a similar manner the effective amount of organic acid needed to retard discoloration and improve storage may range from 0.01% to 5% acid, preferably ascorbic, by weight of the solution, preferably from 0.01% to 2% by weight of the solution.

Generally, effective aqueous solutions containing the composition of the present invention can be prepared having a total solids concentration of roughly from about 10 to 50 g/l of solution, preferably about 20 to 30 g/l. An example of such a solution is the following:

Low D.E. maltodextrin	50 grams
Ascorbic acid	50 grams
Natural vegetable flavor	15 grams
Xanthan gum	10 grams
Water	to 5 litres

Such a solution can be used to treat at least 50 pounds of salad vegetables, or approximately about 100 small individual salad servings, without adding significantly to the cost of an individual salad. In tests on various salads, the aqueous solution formed using the composition of the present invention is able to prevent discoloration, wilting, and drying for long periods of time, thus extending the shelf life of the fruit and vegetable salad ingredients. It is clear that the composition of the present invention can provide an inexpensive, efficient and simple means to extend the shelf life of over-the-counter prepared salads or salad bar items, without adding sulphites, objectionable tastes, or gummy mouthfeel.

The following examples are presented as illustrative of the present invention and are not intended to limit its scope in any way:

#### EXAMPLE 1

Various tests are made with regard to the abilities of particular compounds to prevent deterioration and extend the shelf life of salads. Tests involve the use of solutions with ascorbic acid, xanthan gum, fresh lettuce flavour, water, or combinations of these ingredients. Three solutions are composed by weight percentages as follows:

Solution 1:	Water 100%	
Solution 2:	Ascorbic acid	1.0%
	Xanthan Gum	0.2%
	Water	98.5%
Solution 3:	Ascorbic acid	1.0%
	Xanthan Gum	0.2%
	fresh lettuce flavor	0.1%
	Water	98.7%

Salads are prepared using fresh cut vegetables including lettuce, tomatoes, cucumbers, peppers and radishes. The solutions described above are applied to the salad ingredients by dipping the food in the solutions, and afterwards the salads were stored in the refrigerator in 5-ounce salad dishes with lids. After 5

days, observations are as follows:

(a) Salad treated with Solution 1 (water only):

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Lettuce: Good, but dry, mealy, slightly brown and shriveled.  
Tomato: Dry and shriveled.  
Cucumber: Dry, shriveled and mealy.  
Pepper: Dry, shriveled and mealy.  
10 Radish: Dry, shriveled and mealy.

(b) Salad treated with Solution 2 (Ascorbic acid and xanthan):

- Lettuce: Better than control; crisp and moist.  
15 Tomato: Better than control; crisp and moist.  
Cucumber: Better than control; crisp and moist.  
Pepper: Better than control; crisp and moist.  
Radish: Best condition of series, excellent condition.  
Overall condition: Acceptable for sale.

(c) Salad treated with Solution 3 (Ascorbic acid, xanthan and flavor):

- Lettuce: Best condition of series; crisp and moist.  
Tomato: Best condition of series; crisp and moist.  
25 Cucumber: Best condition of series; crisp and moist.  
Pepper: Best condition of series; crisp and moist.  
Radish: Very good condition; crisp and moist.  
Overall condition: Best overall, acceptable for sale.

30 The various solutions employing ascorbic acid and xanthan gum are thus observed to have excellent results in extending the shelf life of salads. On opening the salad containers treated with solution 3 the flavour and/or aroma enhancement added to the overall quality observed. Obviously, individual salad ingredients can be treated with specific effective active ingredients to maximize the quality of each individual salad ingredient.

EXAMPLE 2

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An aqueous solution made from the composition of the present invention is tested to determine its ability of preserving the freshness and extending the shelf life of fruit salad. Cups of fruit salad are prepared comprised of 1/4 inch irregular cubes of peeled and cut (fresh) Granny Smith apples, whole de-stemmed fresh red seedless grapes, canned mandarin orange sections and canned pineapple chunks. Half of this fruit salad is treated by dipping the cut fruit in a solution of 0.95% ascorbic acid, 0.20% xanthan gum, 0.95% low density maltodextrin, and 97.84% water. The other half of the fruit salad is dipped only in water. The fruit salad is placed in 5-ounce salad dishes with lids and stored in a refrigerator. The observations are as follows:  
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Time of Placem nt in refrigerator	Control (Water Only)	Salad with Solution Appli d
0 days refrigeration	Fresh; good, clean.	Fresh; good, clean.
2 days refrigeration	Moldy grapes, Brown apples.	Fresh; good, clean.
4 days refrigeration	Moldy grapes; Brown, moldy apples; Apples dry.	Fresh; good, clean.
8 days refrigeration	Moldy grapes; Very brown, moldy apples; apples; Apples dry and shrivelling.	Moldy grapes; All else fresh.

The solution employing a composition of the present invention is thus successfully used to extend the shelf life of fruit salads. Obviously, the stability extension of the grapes beyond four days could be achieved by the addition of an antimicrobial active agent to the composition or by treatment of the grapes separately.

### EXAMPLE 3

A composition according to the present invention is produced using the following ingredients:

INGREDIENT	WEIGHT
Low density Maltodextrin,	50 gms (40%)
L-Ascorbic Acid	50 gms (40%)
Natural Vegetable Flavor Leaf Essence G.F.	15 gms (12%)
Xanthan Gum,	10 gms (8%)
TOTAL	125 gms

The above solid ingredients are dissolved in 5 litres of water (11 pounds) and the solution is used to treat 50 pounds of salad vegetables (corresponding to about 100 individual salad servings). The solution prepared was successful and inexpensively extended the shelf life of various prepared salads.

### EXAMPLE 4

A composition according to the present invention is produced as follows:

INGREDIENT	WEIGHT
Low density Maltodextrin,	50 gms (43.40%)
L-Ascorbic Acid	50 gms (43.48%)
Artificial Lettuce Flavor	15 gms (4.3%)
Xanthan Gum,	10 gms (8.70%)
TOTAL	115 gms

The above composition is dissolved in 5 litres of water and is used to treat 50 pounds of salad vegetables, at even less expense than the composition described in Example 3. The composition is successful in extending the shelf life of the individual salad servings.

## Claims

1. A sulphite-free composition suitable for reducing deterioration and/or extending the shelf life of fruits and/or vegetables comprising antidiscolouration agent and edible thixotropic gum.
- 5 2. A composition according to claim 1 wherein said agent comprises edible organic acid, optionally comprising ascorbic acid and/or iso-ascorbic acid.
3. A composition according to claim 1 or 2 wherein said gum comprises one or more of: xanthan gum, guar gum, gum tragacanth, carrageenan gum, alginate gum, and karaya gum.
4. A composition according to any preceding claim wherein said gum comprises xanthan gum.
- 10 5. A composition according to any preceding claim wherein the weight ratio of said agent to said gum is from about 1:1 to about 30:1, preferably about 3:1 to about 5:1.
6. A composition according to any preceding claim comprising ascorbic acid and xanthan gum in a weight ratio of about 3:1 to about 5:1 of acid:gum.
7. A composition according to any preceding claim further comprising edible bulk filler.
- 15 8. A composition according to claim 7 wherein said filler comprises maltodextrin.
9. A composition according to claim 7 or 8 wherein said filler comprises low DE low density maltodextrin.
10. A composition according to any one of claims 7 to 9 wherein the weight ratio of said filler to said agent is about 0.1:1 to 10:1, preferably about 0.3:1 to 3:1.
- 20 11. A composition according to any preceding claim further comprising natural and/or artificial flavouring and/or aromatising agent.
12. A composition according to claim 11 wherein the weight ratio of flavouring agent to antidiscolouration agent is about 0.05:1 to about 1:1.
13. An aqueous composition comprising a solution for reducing deterioration and/or extending the shelf
- 25 life of fruits and/or vegetables comprising a composition as claimed in any preceding claim dissolved in water.
14. An aqueous composition comprising a solution according to claim 13 wherein the total solids concentration is about 10 to 50 g/l of solution.
15. A fruit or vegetable coated with a composition as claimed in any preceding claim.
- 30 16. A method of reducing deterioration and/or extending the shelf life of a fruit or vegetable comprising applying an effective amount of a composition as claimed in any one of claims 1 to 14 to a fruit or vegetable.
17. A method according to claim 16 wherein said effective amount comprises from about 0.19 to 10% by weight of the solid ingredients, based on the weight of the fruit or vegetable to which the composition is
- 35 applied.
18. A method according to claim 16 or 17 wherein the effective amount of thixotropic gum and antidiscolouration agent is each 0.01% to 5% by weight of a solution thereof.

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